

Name: \_\_\_\_\_

### at1204p\_vertex\_and\_roots... from standard-form quadratic functions (v101)

For each quadratic function, find:

1. The equation of the axis of symmetry
2. The distance of each root to the axis of symmetry ( $w$ )
3. Both  $x$ -intercepts (also called the roots or the zeros), each shown as cartesian coordinates
4. The location of the vertex ( $h, k$ ) shown as cartesian coordinates

Your answers should be in simplified exact form, no decimal approximations. Improper fractions are preferred to mixed numbers.

#### Example

$$f(x) = 6x^2 + 4x - 5$$

#### Example solution

1. Find the axis of symmetry. Use the formula  $h = \frac{-b}{2a}$ , where  $h$  is the horizontal coordinate of the vertex. Remember that the vertical axis of symmetry intersects the vertex.

$$h = \frac{-(4)}{2(6)}$$

$$\text{axis of symmetry: } x = \frac{-1}{3}$$

2. Find the distance of each root from the axis of symmetry. Use the formula  $w = \frac{\sqrt{b^2 - 4ac}}{2a}$ .

$$w = \frac{\sqrt{(4)^2 - 4(6)(-5)}}{2(6)}$$

$$w = \frac{\sqrt{136}}{12} = \frac{\sqrt{2 \cdot 2 \cdot 2 \cdot 17}}{12} = \frac{2\sqrt{34}}{12}$$

$$w = \frac{\sqrt{34}}{6}$$

3. The  $x$ -intercepts can be found by adding  $w$  to or subtracting  $w$  from  $h$ .

$$\left(\frac{-1}{3} - \frac{\sqrt{34}}{6}, 0\right) \quad \text{and} \quad \left(\frac{-1}{3} + \frac{\sqrt{34}}{6}, 0\right)$$

4. Find the vertex. We already know  $h = \frac{-1}{3}$ , so we just need  $k$ . Use the formula  $k = \frac{4ac - b^2}{4a}$ .

$$k = \frac{4(6)(-5) - (4)^2}{4(6)}$$

$$k = \frac{-136}{24} = \frac{-17}{3}$$

$$\text{vertex: } \left(\frac{-1}{3}, \frac{-17}{3}\right)$$

## Question 1

For the quadratic function listed below, find:

1. The equation of the axis of symmetry
2. The distance of each root to the axis of symmetry ( $w$ )
3. Both  $x$ -intercepts (also called the roots or the zeros), each shown as cartesian coordinates
4. The location of the vertex ( $h, k$ ) shown as cartesian coordinates

Box your answers.

$$f(x) = 9x^2 + 9x - 7$$

1. Axis of symmetry

$$h = \frac{-(-9)}{2(9)}$$

$$\text{axis of symmetry: } x = \frac{-1}{2}$$

2. Distance from axis of symmetry to root

$$w = \frac{\sqrt{(9)^2 - 4(9)(-7)}}{2(9)}$$

$$w = \frac{\sqrt{333}}{18} = \frac{\sqrt{3 \cdot 3 \cdot 37}}{18} = \frac{3\sqrt{37}}{18}$$

$$w = \frac{\sqrt{37}}{6}$$

3. Roots

$$\left(\frac{-1}{2} - \frac{\sqrt{37}}{6}, 0\right) \quad \text{and} \quad \left(\frac{-1}{2} + \frac{\sqrt{37}}{6}, 0\right)$$

4. Vertex

$$k = \frac{4(9)(-7) - (9)^2}{4(9)}$$

$$k = \frac{-333}{36} = \frac{-37}{4}$$

$$\text{vertex: } \left(\frac{-1}{2}, \frac{-37}{4}\right)$$

## Question 2

For the quadratic function listed below, find:

1. The equation of the axis of symmetry
2. The distance of each root to the axis of symmetry ( $w$ )
3. Both  $x$ -intercepts (also called the roots or the zeros), each shown as cartesian coordinates
4. The location of the vertex ( $h, k$ ) shown as cartesian coordinates

Box your answers.

$$f(x) = 8x^2 + 7x - 10$$

1. Axis of symmetry

$$h = \frac{-(-7)}{2(8)}$$

$$\text{axis of symmetry: } x = \frac{-7}{16}$$

2. Distance from axis of symmetry to root

$$w = \frac{\sqrt{(7)^2 - 4(8)(-10)}}{2(8)}$$

$$w = \frac{\sqrt{369}}{16} = \frac{\sqrt{3 \cdot 3 \cdot 41}}{16} = \frac{3\sqrt{41}}{16}$$

$$w = \frac{3\sqrt{41}}{16}$$

3. Roots

$$\left(\frac{-7}{16} - \frac{3\sqrt{41}}{16}, 0\right) \quad \text{and} \quad \left(\frac{-7}{16} + \frac{3\sqrt{41}}{16}, 0\right)$$

4. Vertex

$$k = \frac{4(8)(-10) - (7)^2}{4(8)}$$

$$k = \frac{-369}{32}$$

$$\text{vertex: } \left(\frac{-7}{16}, \frac{-369}{32}\right)$$

### Question 3

For the quadratic function listed below, find:

1. The equation of the axis of symmetry
2. The distance of each root to the axis of symmetry ( $w$ )
3. Both  $x$ -intercepts (also called the roots or the zeros), each shown as cartesian coordinates
4. The location of the vertex ( $h, k$ ) shown as cartesian coordinates

Box your answers.

$$f(x) = 9x^2 - 2x - 2$$

1. Axis of symmetry

$$h = \frac{-(2)}{2(9)}$$

$$\text{axis of symmetry: } x = \frac{1}{9}$$

2. Distance from axis of symmetry to root

$$w = \frac{\sqrt{(-2)^2 - 4(9)(-2)}}{2(9)}$$

$$w = \frac{\sqrt{76}}{18} = \frac{\sqrt{2 \cdot 2 \cdot 19}}{18} = \frac{2\sqrt{19}}{18}$$

$$w = \frac{\sqrt{19}}{9}$$

3. Roots

$$\left(\frac{1}{9} - \frac{\sqrt{19}}{9}, 0\right) \quad \text{and} \quad \left(\frac{1}{9} + \frac{\sqrt{19}}{9}, 0\right)$$

4. Vertex

$$k = \frac{4(9)(-2) - (-2)^2}{4(9)}$$

$$k = \frac{-76}{36} = \frac{-19}{9}$$

$$\text{vertex: } \left(\frac{1}{9}, \frac{-19}{9}\right)$$